REMARKS/ARGUMENTS

Reconsideration is respectfully requested.

Claims 1-24 are pending before this amendment. By the present amendment, claims 1, 7, 11, 17, and 21 are amended. No new matter has been added.

Allowable Subject Matter

In the office action (page 5), the examiner indicates claims 4-6, 8-10, 14-16, 18-20 and 22-23 as allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claim. The applicants thank the examiner for this indication of allowable subject matter. The applicants have amended independent claims 1, 7, 11, 17, and 21 to include the gist of the allowable subject matter of claims 4-6, 8-10, 14-16, 18-20 and 22-23 without including all of the limitations of these claims with the intention of inviting a notice of allowance. Therefore, the applicants respectfully submit that claim 1 (and similarly claims 7, 11, 17, and 21), which have been amended to clarify the presently claimed invention, is allowable over the cited prior art references as is discussed below.

In the office action (page 2), figs. 1-3 stand objected to as needing to be labeled with a legend such as "Prior Art". In response, the applicant has amended FIGs. 1-3 to include the --**PRIOR ART**-- designation. Withdrawal of the objection is respectfully requested.

In the office action (page 3), claims 1-3, 7, 11-13, 17, 21 and 24 stand rejected under 35 U.S.C. §102(e) as being anticipated by U.S. Patent No. 7,194,047 (Strolle). The "et al." suffix is omitted from the Strolle reference name.

The applicant has amended claim 1 (and similarly claim 7, 11, 17, and 21) to clarify the presently claimed invention and to traverse the Examiner's rejection.

The presently claimed invention relates to a Vestigial Side Band (VSB) digital television (DTV) transmitter and receiver based on terrestrial DTV Standards, which is A/53 of the Advanced Television System Committee (ATSC). More particularly, the presently claimed invention relates to a DTV transmitter and receiver using 16-state trellis coding such that the trellis coding to performs a 16-state trellis decoding/encoding on the robust data, **which a received/transmitted data symbol average power does not increase when a ratio of the robust data mixed with the normal data increases** (specification at page 1, lines 6-12).

To further explain, generally transmission signals of a conventional 8-VSB transceiver are distorted in indoor and mobile channel environments due to variable channel and multipath phenomena, and this degrades reception performance of the receiver.

In other words, general transmission signals of a conventional 8-VSB having transmitted data are affected by various channel distortion factors. The channel distortion factors include a multipath phenomenon, frequency offset, phase jitter and the like. To compensate for the signal distortion caused by the channel distortion factors, a training data sequence is transmitted every 24.2ms, but a change in multipath characteristics and Doppler interference exist even in the time interval of 24.2ms that the training data sequences are transmitted. Since an equalizer of the receiver does not have a convergence speed fast enough to compensate for the distortion of receiving signals, which occurs by the change in multipath characteristics and the Doppler

interference, the receiver cannot perform equalization precisely.

For this reason, the broadcasting program reception performance of 8-VSB DTV broadcast is lower than that of an analog broadcast and reception is impossible in a mobile receiver. Even if reception is possible, there is a problem in the prior art that a signal-to-noise ratio (SNR) satisfying Threshold of Visibility (TOV) increases.

To solve the problems, the prior art discloses technology for transmitting robust data by any one among 4-level symbols, e.g., {-7,-5,5,7} or {-7,-3,3,7}. Since the symbols to which **robust data are mapped are limited in the conventional technology**. However, there is a problem with this above solution such that the average power of the symbols corresponding to the robust data is **increased compared to conventional 8-VSB method**. In other words, when robust data are transmitted by any one among four level symbols {-7,-5,5,7}, symbol average power is 37 energy/symbol, or if robust data are transmitted by any one among four level symbols {-7,-3,3,7}, symbol average power is 29 energy/symbol, **which signifies that the average power of the symbol corresponding to the robust data is increased compared to the conventional 8-VSB method**. This increase in the symbol average power leads to **increase in the entire average power**. Accordingly, as the examiner understands, the presently claimed invention overcomes this prior art problem of signals be transmitted with a limited transmission power when robust data is transmitted with normal data. That is, the presently claimed invention overcomes the transmission power of normal data from being reduced compared to the conventional 8-VSB method such that the presently claimed invention eliminates the normal data having poor reception performance from the reduction in power than the conventional 8-VSB method

in the same channel environment.

Further, the above problem solved by the prior art becomes more serious **when the ratio of robust data mixed with normal data is increased**, because the SNR satisfying the TOV is increased. As a result, the reception performance is degraded, even though the channel environment is fine and wherein it is likely to happen that backward compatibility cannot be provided for an 8-VSB receiver.

Therefore, the applicants have amended independent claim 1 (and similarly independent claims 7, 11, 17, and 21) to overcome the prior art energy/symbol average power from robust data being transmitted by any one among four level symbols {-7,-3,3,7}, which the examiner understands from the indicated allowable subject matter in claims 4-6, 8-10, 14-16, 18-20 and 22-23. Accordinlgy, the claims have been amended to claim the gist of the allowable subject matter without incorporating the exact limitations of the allowable subject matter in independent form including all of the limitations of the base claim and any intervening claim with the intention of inviting a notice of allowance. Claim 1 (and similarly claims 7, 11, 17, and 21) now recites, inter alia:

> –wherein the encoding means **is configured to perform** ~~**performs**~~ 16-state trellis coding on the robust data **without raising a transmitted data symbol average power when a ratio of the robust data mixed with the normal data increases**–.

Support for the limitations added to claim 1 can be found on at least specification at page 28, line 20 to page 31, line 21; and FIGs. 9-10.

As clearly understood by the Examiner, nowhere in Strolle teaches or discloses having an encoding/decoding means which is configured to perform 16-state trellis coding on the robust data without raising a transmitted/received data symbol average

power when a ratio of the robust data mixed with the normal data increases, recited in amended claim 1.

In contradistinction, the presently claimed invention improves on a method for coding robust data by using the robust encoder 411 and the trellis encoder 415 is already suggested by the Phillips Company. Fig. 9 is a block diagram describing trellis coding of robust data, which the presently claimed invention improves on the Philips company's robust encoder 411 and their trellis encoder 415 as follows.

> "a robust encoder 911 outputs the trellis encoded symbols Z0, Z1 and Z2 in four levels by equalizing the coded values Z2 and Z1 of a trellis encoder 915 obtained through a precoder remover based on the value X1' between the inputted signals X1' and X2'.
>
> The robust data coding method suggested by the Philips Company has a problem that **the average power of symbols representing robust data is increased compared to the conventional 8-VSB method because the output symbols of the trellis encoder 915 use four levels {-7,-5,5,7}.**
>
> In other words, when robust data are mapped to any one among four-level symbols of {-7,-5,5,7}, the average power of symbols becomes 37 energy/symbol, which is higher than the conventional 8-VSB method. The increase in the average power of the symbols indicating robust data increases the entire average power, and when a signal is transmitted with limited transmission output power, the transmission power of normal data is decreased relatively. Thus, the receiver comes to have inferior reception performance to the conventional 8-VSB method in the same channel environment.
>
> **The problem becomes more serious, as the rate of the robust data mixed with normal data increases.** Thus, the SNR satisfying the TOV is increased. Accordingly, the reception performance can be degraded even though the channel environment is fine, and backward compatibility for a receiver based on the 8-VSB method may not be provided depending on circumstances.
>
> **Therefore, the present invention suggests a method that does not raise the symbol average power regardless of the rate of the robust data by using a 16-state trellis coding method with respect to robust data.**
>
> Fig. 10 is a block diagram illustrating trellis coding of robust data in accordance with an embodiment of the present invention.
>
> As shown, an input signal X1' is coded by adding registers D4 and D5 for generating robust data to a robust encoder 1011.

The output signal of a trellis encoder 1015 based on the input signal X1' and the subsequent state are as shown in Tables 3 and 4.

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Table 3

CURRENT STATE \ INPUT	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0	-7	-5	-7	-5	1	3	1	3	-3	-1	-3	-1	5	7	5	7
1	1	3	1	3	-7	-5	-7	-5	5	7	5	7	-3	-1	-3	-1

Table 4

CURRENT STATE \ INPUT	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0	0	2	1	3	8	2	1	3	5	7	4	6	5	7	4	6
1	12	14	13	15	12	14	13	15	9	11	8	10	9	11	8	10

The 16 states of Table 16 are calculated based on an equation 4.

$$S = D_4 \times 8 + D_5 \times 4 + D_2 \times 2 + D_3 \qquad \text{Eq. 4}$$

Meanwhile, the state values of the registers D4 and D5 additionally used to generate robust data are not changed when normal data are inputted, and the output signals based on input and the subsequent state are as shown in Tables 5 and 6.

Table 5

CURRENT STATE \ INPUT	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0	-7, 1	-5, 3	-7, 1	-5, 3	-7, 1	-5, 3	-7, 1	-5, 3	-7, 1	-5, 3	-7, 1	-5, 3	-7, 1	-5, 3	-7, 1	-5, 3
1	-3,	-1,	-3,	-1,	-3,	-1,	-3,	-1,	-3,	-1,	-3,	-1,	-3,	-1,	-3,	-1,

Table 6

CURRENT STATE \ INPUT	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0	0	2	1	3	4	6	5	7	8	10	9	11	12	14	13	15
1	1	3	0	2	5	7	4	6	9	11	8	10	13	15	12	14

When robust data are generated by using 16-state trellis coding in accordance with the present embodiment, the performance of a receiver can be improved by designing a trellis decoder and a signal level detector with reference to the Tables 3 and 4",

(specification at page 28, line 20 to page 31, line 21)

As disclosed above by the presently claimed invention over the prior art, in case of a normal data signal, the signal level is determined in four states with respect to an 8-level {-7,-5,-3,-1,1,3,5,7}, which is the same as the conventional technology. In case of a robust data signal, the signal level is determined with respect to an 8-level {-7,-5,-3,-1,1,3,5,7} which is trellis coded in 16 states. That is, with respect to a normal data signal, 4-state trellis decoding is carried out on an 8-level signal {-7,-5,-3,-1,1,3,5,7}, which is the same as the conventional technology. With respect to a robust data signal, trellis decoding is performed on the 8-level signal which is trellis coded in 16 states and shown in Tables 3 and 4.

According to the presently claimed invention, the 8-VSB receiver based on the ATSC A/53 receives a normal data packet and the 8-VSB receiver provides backward compatibility by processing a robust data packet as a null packet.

Therefore, the applicants respectfully submit, as noted by the examiner for allowing the subject matter of claims 4-6, 8-10, 14-16, 18-20 and 22-23 (OA page 7), that Strolle fails to teach or disclose the limitations of amended claim 1, which incorporates the important limitations of the allowable subject matter of claims 4-6, 8-10, 14-16, 18-20 or 22-23, which recites inter alia: --wherein the encoding means is configured to perform 16-state trellis coding on the robust data without raising a transmitted data symbol average power when a ratio of the robust data mixed with the normal data increases--.

Independent claims 7, 11, 17, and 21 recites similar features to those found in claim 1. Therefore, for reasons analogous to those argued above with respect to claim 1, claims 7, 11, 17, and 21 are patentable over the applied references.

As to claims 2-3, 8-9, 12-13, and 24, the applicants respectfully submit that these claims are allowable at least since they depend from either claim 1, claim 7, claim 11, claim 17, or claim 21, which are now considered to be in condition for allowance for the reasons mentioned above for claim 1.

For the reasons set forth above, the applicants respectfully submit that claims 1-24, now pending in this application, are in condition for allowance over the cited references. Accordingly, the applicants respectfully request reconsideration and withdrawal of the outstanding rejections and earnestly solicit an indication of allowable subject matter.

This amendment is considered to be responsive to all points raised in the office action. Should the examiner have any remaining questions or concerns, the examiner is encouraged to contact the undersigned attorney by telephone to expeditiously resolve such concerns.

Respectfully submitted,

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APPENDIX OF ATTACHMENTS

Replacement Sheets of FIGS. 1-3
(a total of 3 sheets of drawings)